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EXAMINER

CROWELL, ANNA M

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**BEFORE THE BOARD OF PATENT APPEALS
AND INTERFERENCES**

Application Number: 10/052,538
Filing Date: January 23, 2002
Appellant(s): KAJI ET AL.

Gregory E. Montone
For Appellant

EXAMINER'S ANSWER

Antonelli, Terry, Stout, & Kraus, LLP
1300 North Seventeenth St., Suite 1800

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Arlington, VA 22209

This is in response to the appeal brief filed July 23, 2008 appealing from the Office action mailed July 17, 2007.

(1) Real Party in Interest

A statement identifying by name the real party in interest is contained in the brief.

(2) Related Appeals and Interferences

The following are the related appeals, interferences, and judicial proceedings known to the examiner which may be related to, directly affect or be directly affected by or have a bearing on the Board's decision in the pending appeal:

It is noted that related application Serial No. 10/808559, filed on May 25, 2004, is presently before the Board of Appeals.

(3) Status of Claims

The statement of the status of claims contained in the brief is substantially correct. Claims 75-98 are pending in the application. Appellant's elected Species III which is directed to Fig. 28, claims 87-92. Thus, claims 87-92 are finally rejected. Claims 75-86 and 93-98 are withdrawn from consideration. Claims 1-74 of the application have been canceled.

(4) Status of Amendments After Final

No amendment after final has been filed.

(5) Summary of Claimed Subject Matter

The summary of claimed subject matter contained in the brief is correct.

The present invention is directed to a plasma etching apparatus for processing a sample having a diameter of 300 mm or more. The apparatus includes a vacuum processing chamber, a pair of electrodes, a gas introducing means, a magnetic field forming means, a means for etching a fine pattern on the sample, and a bias electric power source. The means for etching a fine pattern on the sample comprises a high frequency electric power source, a specified electrode gap, an evacuation means, and a magnetic field forming means. The gas introducing means introducing an etching gas containing at least fluorine and carbon into the vacuum processing chamber. The magnetic forming means includes a pair of coils arranged so that the magnetic flux created by one of the coils cancels the magnetic flux of the other coils at the center of the sample and superposes on the magnetic flux of the other coils at the portion within the outer periphery of the sample. The high frequency electric power source supplies high frequency energy (30 MHz-300 MHz) for generating plasma between the pair of electrodes. The electrode gap is between 30 mm and 100 mm. The evacuation means sets the atmospheric pressure inside the chamber to 0.4 Pa and 4.0 Pa. The magnetic forming means sets the magnetic field to smaller than 30 gauss. The density of the plasma used to process the sample ranges between $5 \times 10^{10} \text{ cm}^{-3}$ and $5 \times 10^{11} \text{ cm}^{-3}$. The bias electric power source is connected to one of the electrodes to control the energy of ions in the plasma. Furthermore, the magnetic field forming means forms a magnetic field designed to generate increased plasma density at a portion within an outer periphery of the sample which is greater than the plasma density at the center of the sample.

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(6) Grounds of Rejection to be Reviewed on Appeal

The appellant's statement of the grounds of rejection to be reviewed on appeal is correct.

The issues are if:

1. Claim 92 is rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the written description requirement.
2. Claims 87-92 are rejected under 35 U.S.C. 103(a) as being unpatentable over Collins et al. (U.S. 5,300,460) in view of Ohmi (U.S. 5,272,417), Lenz et al. (U.S. 5,609,720), Heinrich et al. (U.S. 5,527,394), and Mintz et al. (U.S. 5,223,457).
3. Claims 87-92 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ohmi (U.S. 5,272,417) in view of Collins et al., Lenz et al. (U.S. 5,609,720), Heinrich et al. (U.S. 5,527,394), and Mintz et al. (U.S. 5,223,457).
4. Claims 87-92 are rejected under 35 U.S.C. 103(a) as being unpatentable over Koshiishi et al. (U.S. 5,919,332) in view of Lenz et al. (U.S. 5,609,720) and Collins et al. (U.S. 5,300,460), Heinrich et al. (U.S. 5,527,394), and Mintz et al. (U.S. 5,223,457).

(7) Claims Appendix

The copy of the appealed claims contained in the Appendix to the brief is correct.

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(8) Evidence Relied Upon

5,300,460	COLLINS et al	04-1994
5,272,417	OHMI	12-1993
5,609,720	LENZ et al	03-1997
5,527,394	HEINRICH et al	06-1996
5,223,457	MINTZ et al	06-1993
5,919,332	KOSHIISHI et al	07-1999

(9) Grounds of Rejection

The following ground(s) of rejection are applicable to the appealed claims:

Claim 92 is rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the written description requirement. The claim(s) contains subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention.

Claim 92 requires “to etch a fine pattern of 0.2 μm or smaller on the sample”. The specification portion of the current invention fails to disclose this feature. The prior art (col. 3, lines 33-37, USP 6,197,151) indicates that it is difficult to manufacture a fine pattern of 0.2 μm or smaller on the sample. The current invention simply requires “to manufacture a **fine pattern** (no dimensions are given for the fine pattern) on a large sized sample having a diameter of 300 mm or more (col. 5, lines 7-10), not specifically a fine pattern of 0.2 μm or smaller on the sample.

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Claims 87-92 are rejected under 35 U.S.C. 103(a) as being unpatentable over Collins et al. (U.S. 5,300,460) in view of Ohmi (U.S. 5,272,417), Lenz et al. (U.S. 5,609,720), Heinrich et al. (U.S. 5,527,394), and Mintz et al. (U.S. 5,223,457).

Referring to column 8, line 28-column 9, line 68, Collins et al. discloses a plasma processing apparatus comprising: a vacuum processing chamber (col. 7, lines 10-20), a pair of electrodes opposite to each other that are disposed in the vacuum processing chamber, one of the electrodes being used also as a sample table capable of holding a sample having a diameter of 127 mm containing an insulator (col. 7, lines 10-20, col. 8, line 44, col. 9, line 45), a gas introducing means capable of introducing a fluorine-containing etching gas into the vacuum processing chamber (col. 8, line 64, col. 9, line 15), a means for applying a high-frequency electric power of 50-600 MHz (col. 8, lines 28-34) between the pair of electrodes whose gap is set to 50-300 mm (col. 8, lines 35-43) and for setting a pressure inside the vacuum chamber to 0.267-26.66 Pa (col. 53-57).

Collins et al. discloses a sample diameter of 127 mm; yet, fails to explicitly teach the diameter of the sample being 300 mm or more; however, it is still obvious.

Referring to column 2, lines 35-41, Lenz et al. teaches that it is conventionally known in the art to process a wafer having a diameter of 300 mm. Thus, it would have been obvious to scale up the apparatus of Collins et al. to process a wafer having a diameter of 300 mm since it is conventionally known in the art to process wafers having a diameter of 300 mm. Additionally, according to *In Gardner v. TEC Systems, Inc.*, 725 F.2d 1338, 220 USPQ 777 (Fed. Cir. 1984), cert. denied, 469 U.S. 830, 225 USPQ 232 (1984), the Federal Circuit held that, where the only difference between the prior art and the claims was a recitation of relative dimensions of the

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claimed device and a device having the claimed relative dimensions would not perform differently than the prior art device, the claimed device was not patentably distinct from the prior art device. Thus, it would have been obvious to one of ordinary skill in the art at the time of the invention to scale up/down the apparatus of Collins et al. in order to process a sample with a diameter of 300 mm or more.

Collins et al. fails to disclose a magnetic forming means, including a pair of coils, for forming a magnetic field designed to generate increased plasma density at a portion within an outer periphery of the sample which is greater than the plasma density at the center of the sample.

Referring to Figure 2c and column 5, lines 26-53, Heinrich et al. teach a magnetic field forming means ((Sp)), including a pair of coils, for forming a magnetic field designed to generate increased plasma density at a portion within an outer periphery of the sample which is greater than the plasma density at the center of the sample in order to enhance process uniformity. Thus, it would have been obvious to one of ordinary skill in the art at the time of the invention to modify the magnetic forming means of Collins et al. with the magnetic forming means as taught by Heinrich et al. in order to enhance process uniformity.

Collins et al. in view of Heinrich et al., fails to teach the magnetic field smaller than 30 gauss.

Referring to column 6, lines 51-59, Mintz teaches a plasma etching apparatus using a magnetic field less than 30 gauss (between 1-20 gauss) in order to deflect plasma ions and thereby prevent wafer contamination. Thus, it would have been obvious to one of ordinary skill in the art at the time of the invention for the magnetic field forming means of Collins et al. in

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view of Heinrich et al., with a magnetic field intensity less than 30 gauss as taught by Mintz et al. in order to deflect plasma ions and thereby prevent wafer contamination.

Collins et al. fails to disclose a bias electric power source.

Referring to Figure 1 and column 6, lines 62-68, Ohmi teaches a bias electric power source 110 connected to sample table 104 for generating a bias voltage. It is conventionally known in the art bias the sample table since this would change the energy of the ions reaching the sample surface in order to control the selectivity ratio. Thus, it would have been obvious to one of ordinary skill in the art at the time of the invention to provide the apparatus of Collins et al. with a bias electric power connected to the sample table since this would change the energy of the ions reaching the sample surface in order to control the selectivity ratio.

With respect to the plasma density, Collins et al. discloses a high frequency electric power source of 50-600 MHz, an electrode spacing of 50-300 mm, and a pressure of 0.267-26.66 Pa. It is known in the art to appropriately select the chamber conditions in order to generate high density plasma. Furthermore, it should be noted that plasma density is not a parameter that is set or controlled directly. In fact, plasma density is set as a result of controlling process parameters such as pressure, power, and electrode spacing. Thus, since Collins et al. disclose a high frequency electric power source of 50-600 MHz, an electrode spacing of 50-300 mm, and a pressure of 0.267-26.66 Pa., it is inherent that the resulting plasma density generated in Collins in view of Ohmi et al. and Lenz et al. will fall between the range of $5 \times 10^{10} \text{ cm}^{-3}$ to $5 \times 10^{11} \text{ cm}^{-3}$.

With respect to the “to etch a fine pattern of 0.2 μm or smaller on the sample having a diameter of 300 mm or more”, this limitation is considered a process limitation. The apparatus of Collins in view of Ohmi et al. and Lenz et al. is capable of being used to produce such a fine

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pattern of 0.2 μm or smaller on the sample having a diameter of 300 mm or more by simply optimizing the power, pressure, and electrode spacing. Furthermore, apparatus claims cover what a device is, not what a device does.

Regarding the limitation of “fluorine-containing etching gas”, the type of gas used in apparatus claims is considered intended use and therefore is of no significance in determining patentability. Expressions relating the apparatus to contents thereof during an intended operation are of no significance in determining patentability of the apparatus claim. *Ex parte Thibault*, 164 USPQ 666, 667 (Bd. App. 1969). Furthermore, the apparatus of Ohmi is capable of providing a fluorine containing etching gas to the sample.

Regarding the limitation of “an insulator film in the sample”, this is considered intended use and therefore is of no significance in determining patentability. The inclusion of material or article worked upon by a structure being claimed does not impart patentability to the claims.” *In re Young*, 75 F.2d 966, 25 USPQ 69 (CCPA 1935) (as restated in *In re Otto*, 312 F.2d 937, 136 USPQ 458, 459 (CCPA 1963). Moreover, the apparatus of Collins et al. is capable of processing an insulator film in the sample.

Regarding the above apparatus claims, it should be noted that a claim containing a “recitation with respect to the manner in which a claimed apparatus is intended to be employed does not differentiate the claimed apparatus from a prior art apparatus” if the prior art apparatus teaches all the structural limitations of the claim. *Ex parte Masham*, 2 USPQ2d 1647 (Bd. Pat. App. & Inter. 1987).

Second Art Rejection

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Claims 87-92 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ohmi (U.S. 5,272,417) in view of Collins et al., Lenz et al. (U.S. 5,609,720), Heinrich et al. (U.S. 5,527,394), and Mintz et al. (U.S. 5,223,457).

Referring to Figure 1, column 6, line 25-column 7, line 6, and column 8, line 61-68, Ohmi discloses a plasma processing apparatus comprising: a vacuum processing chamber 105 (col. 6, lines 27-28), a pair of electrodes 102, 104 opposite to each other that are disposed in the vacuum processing chamber, one of the electrodes 104 being used also as a sample table capable of holding a sample having a diameter of 254 mm containing an insulator film (col. 6, lines 25-27, col. 12, lines 12-15, col. 15, lines 64-68), a gas introducing means capable of introducing a fluorine-containing etching gas into the vacuum processing chamber (col. 6, lines 30-31, col. 8, lines 65-66), means for applying a high frequency electric power of 100 MHz –250 MHz is applied between the pair of electrodes (col. 8, lines 23-27, col. 4, lines 31-33) whose gap is set to 30 mm (col. 8, line 24) and for setting a pressure inside the vacuum processing chamber to 0.933 Pa (col. 8, line 25), bias electric power source 110 connected to the one electrode 104 (col. 6, lines 62-68).

Ohmi fails to specifically teach a motivation for the processing parameters and a pressure range of 1.0 to 4.0 Pa.

Referring to column 8, lines 28-57, Collins et al. additionally teaches a means for applying a high-frequency electric power of 50-600 MHz (col. 8, lines 28-34) between the pair of electrodes whose gap is set to 50-300 mm (col. 8, lines 35-43) and for setting a pressure inside the vacuum chamber to 0.267-26.66 Pa (col. 53-57) so that anisotropic etch will occur at the desired etch rate. Thus, it would have been obvious to one of ordinary skill in the art at the time

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of the invention to operate the apparatus of Ohmi with the process parameters and specifically the pressure range of Collins et al. so that anisotropic etch will occur at the desired etch rate.

Ohmi discloses a sample diameter of 254 mm; yet, fails to explicitly teach the diameter of the sample being 300 mm or more; however, it is still obvious.

Referring to column 2, lines 35-41, Lenz et al. teaches that it is conventionally known in the art to process a wafer having a diameter of 300 mm. Thus, it would have been obvious to scale up the apparatus of Ohmi to process a wafer having a diameter of 300 mm since it is conventionally known in the art to process wafers having a diameter of 300 mm. Additionally, according to In Gardner v. TEC Systems, Inc., 725 F.2d 1338, 220 USPQ 777 (Fed. Cir. 1984), cert. denied, 469 U.S. 830, 225 USPQ 232 (1984), the Federal Circuit held that, where the only difference between the prior art and the claims was a recitation of relative dimensions of the claimed device and a device having the claimed relative dimensions would not perform differently than the prior art device, the claimed device was not patentably distinct from the prior art device. Thus, it would have been obvious to one of ordinary skill in the art at the time of the invention to scale up/down the apparatus of Ohmi in order to process a sample with a diameter of 300 mm or more.

Ohmi fails to disclose a magnetic forming means, including a pair of coils, for forming a magnetic field designed to generate increased plasma density at a portion within an outer periphery of the sample which is greater than the plasma density at the center of the sample.

Referring to Figure 2c and column 5, lines 26-53, Heinrich et al. teach a magnetic field forming means ((Sp)), including a pair of coils, for forming a magnetic field designed to generate increased plasma density at a portion within an outer periphery of the sample which is greater

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than the plasma density at the center of the sample in order to enhance process uniformity. Thus, it would have been obvious to one of ordinary skill in the art at the time of the invention to modify the magnetic forming means of Ohmi with the magnetic forming means as taught by Heinrich et al. in order to enhance process uniformity.

Ohmi in view of Heinrich et al., fails to teach the magnetic field smaller than 30 gauss.

Referring to column 6, lines 51-59, Mintz teaches a plasma etching apparatus using a magnetic field less than 30 gauss (between 1-20 gauss) in order to deflect plasma ions and thereby prevent wafer contamination. Thus, it would have been obvious to one of ordinary skill in the art at the time of the invention for the magnetic field forming means of Ohmi in view of Heinrich et al., with a magnetic field intensity less than 30 gauss as taught by Mintz et al. in order to deflect plasma ions and thereby prevent wafer contamination.

With respect to the plasma density, Ohmi et al. and Collins et al. discloses a high frequency electric power source of 10-250 MHz, an electrode spacing of 30 mm, and a pressure of 0.267-26.66 Pa. It is inherently known in the art the high density plasma is generated from the appropriate chamber conditions. Furthermore, it should be noted that plasma density is not a parameter that is set or controlled directly. In fact, plasma density is set as a result of controlling process parameters such as pressure, power, and electrode spacing. Thus, since Ohmi et al. and Collins et al. disclose a high frequency electric power source of 10-250 MHz, an electrode spacing of 30 mm, and a pressure of 0.267-26.66 Pa, it is inherent that the resulting plasma density generated in Ohmi in view of Collins et al. and Lenz et al. will fall between the range of $5 \times 10^{10} \text{ cm}^{-3}$ to $5 \times 10^{11} \text{ cm}^{-3}$.

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With respect to the “to etch a fine pattern of 0.2 μm or smaller on the sample having a diameter of 300 mm or more”, this limitation is considered a process limitation. The apparatus of Collins in view of Ohmi et al. and Lenz et al. is capable of being used to produce such a fine pattern of 0.2 μm or smaller on the sample having a diameter of 300 mm or more by simply optimizing the power, pressure, and electrode spacing. Furthermore, apparatus claims cover what a device is, not what a device does.

Regarding the limitation of “fluorine-containing etching gas”, the type of gas used in apparatus claims is considered intended use and therefore is of no significance in determining patentability. Expressions relating the apparatus to contents thereof during an intended operation are of no significance in determining patentability of the apparatus claim. *Ex parte Thibault*, 164 USPQ 666, 667 (Bd. App. 1969). Furthermore, the apparatus of Ohmi is capable of providing a fluorine containing etching gas to the sample.

Regarding the limitation of “a pressure condition of 0.5 Pa to 4.0 Pa”, this is considered intended use and therefore is of no significance in determining patentability. The apparatus of Ohmi is capable of providing a pressure condition of 0.5 Pa to 4.0 Pa.

Regarding the limitation of “an insulator film in the sample”, this is considered intended use and therefore is of no significance in determining patentability. The inclusion of material or article worked upon by a structure being claimed does not impart patentability to the claims.” In *re Young*, 75 F.2d 966, 25 USPQ 69 (CCPA 1935) (as restated in *In re Otto*, 312 F.2d 937, 136 USPQ 458, 459 (CCPA 1963). Moreover, the apparatus of Ohmi is capable of processing an insulator film in the sample.

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Regarding the above apparatus claims, it should be noted that a claim containing a “recitation with respect to the manner in which a claimed apparatus is intended to be employed does not differentiate the claimed apparatus from a prior art apparatus” if the prior art apparatus teaches all the structural limitations of the claim. Ex parte Masham, 2 USPQ2d 1647 (Bd. Pat. App. & Inter. 1987).

Third Art Rejection

Claims 87-92 are rejected under 35 U.S.C. 103(a) as being unpatentable over Koshiishi et al. (U.S. 5,919,332) in view of Lenz et al. (U.S. 5,609,720) and Collins et al. (U.S. 5,300,460), Heinrich et al. (U.S. 5,527,394), and Mintz et al. (U.S. 5,223,457).

Referring to Figure 1 and column 9, line 7-column 13, line 17, Koshiishi et al. discloses a plasma etching apparatus comprising a vacuum processing chamber 2 (Fig. 1) and a pair of electrodes 6, 21 opposite to each other that are disposed in the vacuum processing chamber (col.9, lines 66-67), one of the electrodes being used also as a sample table 6 capable of holding a sample containing an insulator film (col. 11, line 40), wherein the plasma etching apparatus further comprises: a gas introducing means 23, 27 for introducing an etching gas containing at least fluorine and carbon into the vacuum processing chamber (col. 10, lines 17-24); means for generating a plasma with a density of $5 \times 10^{10} \text{ cm}^{-3}$ to $5 \times 10^{11} \text{ cm}^{-3}$ between the pair of electrodes to provide a substantially uniform plasma over the sample or more to etch a fine pattern on the sample (col. 13, lines 14-17); and a bias electric power source 44 connected to one of the electrodes to control energy of ions in the plasma (col. 11, lines 17-23).

Koshiishi et al. fail to specifically teach the sample having a diameter of 300 mm.

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Referring to column 2, lines 35-41, Lenz et al. teaches that it is conventionally known in the art to process a wafer having a diameter of 300 mm. Thus, it would have been obvious to scale up the apparatus including the table of Koshiishi et al. to process a wafer having a diameter of 300 mm since it is conventionally known in the art to process wafers having a diameter of 300 mm. Additionally, according to *In Gardner v. TEC Systems, Inc.*, 725 F.2d 1338, 220 USPQ 777 (Fed. Cir. 1984), cert. denied, 469 U.S. 830, 225 USPQ 232 (1984), the Federal Circuit held that, where the only difference between the prior art and the claims was a recitation of relative dimensions of the claimed device and a device having the claimed relative dimensions would not perform differently than the prior art device, the claimed device was not patentably distinct from the prior art device. Thus, it would have been obvious to one of ordinary skill in the art at the time of the invention to scale up/down the apparatus including the table of Koshiishi et al. in order to process a sample with a diameter of 300 mm or more and additionally the motivation for optimizing the size of the table is to enable the table to hold the desired size of substrate.

The teachings of Koshiishi et al. in view of Lenz et al. have been discussed above.

Koshiishi et al. in view of Lenz et al. fail to explicitly teach a power of 30 MHz to 300 MHz; however, the combination (specifically Koshiishi et al., col. 11, lines 23-29) teaches that the apparatus is capable of operating a power source 47 at a frequency higher than 1 MHz.

Additionally, referring to column 7, lines 37-54, Collins teaches that it is conventionally known in the art to use a power source in a frequency range of 30 MHz to 300 MHz since it enhances the etch rate and reduces microloading effects. Thus, it would have been obvious to one of ordinary skill in the art at the time of the invention for the frequency range of the power

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source of Koshiishi et al. in view of Lenz et al. to operate between 30 MHz to 300 MHz as taught by Collins et al. since it enhances the etch rate and reduces microloading effects.

Koshiishi et al. fails to specifically teach a motivation for a pressure range of 0.4 to 4.0 Pa.

Referring to column 8, lines 28-57, Collins et al. additionally teaches setting a pressure inside the vacuum chamber to 0.267-26.66 Pa (col. 53-57) so that anisotropic etch will occur at the desired etch rate. Thus, it would have been obvious to one of ordinary skill in the art at the time of the invention to operate the apparatus of Koshiishi et al. with the pressure range of Collins et al. so that anisotropic etch will occur at the desired etch rate.

Koshiishi et al. fail to disclose a magnetic forming means, including a pair of coils, for forming a magnetic field designed to generate increased plasma density at a portion within an outer periphery of the sample which is greater than the plasma density at the center of the sample.

Referring to Figure 2c and column 5, lines 26-53, Heinrich et al. teach a magnetic field forming means ((Sp), including a pair of coils, for forming a magnetic field designed to generate increased plasma density at a portion within an outer periphery of the sample which is greater than the plasma density at the center of the sample in order to enhance process uniformity. Thus, it would have been obvious to one of ordinary skill in the art at the time of the invention to modify the magnetic forming means of Koshiishi et al. with the magnetic forming means as taught by Heinrich et al. in order to enhance process uniformity

Koshiishi et al. in view of Heinrich et al., fails to teach the magnetic field smaller than 30 gauss.

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Referring to column 6, lines 51-59, Mintz teaches a plasma etching apparatus using a magnetic field less than 30 gauss (between 1-20 gauss) in order to deflect plasma ions and thereby prevent wafer contamination. Thus, it would have been obvious to one of ordinary skill in the art at the time of the invention for the magnetic field forming means of Koshiishi et al. in view of Heinrich et al., with a magnetic field intensity less than 30 gauss as taught by Mintz et al. in order to deflect plasma ions and thereby prevent wafer contamination.

With respect to the “to etch a fine pattern of 0.2 μm or smaller on the sample having a diameter of 300 mm or more”, this limitation is considered a process limitation. The apparatus of Koshiishi et al. in view of Lenz et al. discloses a plasma density of $5 \times 10^{10} \text{ cm}^{-3}$ to $5 \times 10^{11} \text{ cm}^{-3}$ and thus the apparatus is capable of being used to produce such a fine pattern of 0.2 μm or smaller on the sample having a diameter of 300 mm or more by simply optimizing the power, pressure, and electrode spacing. Furthermore, apparatus claims cover what a device is, not what a device does.

Regarding the limitation of “fluorine-containing etching gas”, the type of gas used in apparatus claims is considered intended use and therefore is of no significance in determining patentability. Expressions relating the apparatus to contents thereof during an intended operation are of no significance in determining patentability of the apparatus claim. Ex parte Thibault, 164 USPQ 666, 667 (Bd. App. 1969). Furthermore, the apparatus of Ohmi is capable of providing a fluorine containing etching gas to the sample.

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Regarding the limitation of “a pressure condition of 0.5 Pa to 4.0 Pa”, this is considered intended use and therefore is of no significance in determining patentability. The apparatus of Ohmi is capable of providing a pressure condition of 0.5 Pa to 4.0 Pa.

Regarding the limitation of “an insulator film in the sample”, this is considered intended use and therefore is of no significance in determining patentability. The inclusion of material or article worked upon by a structure being claimed does not impart patentability to the claims.” In *re Young*, 75 F.2d 966, 25 USPQ 69 (CCPA 1935) (as restated in *In re Otto*, 312 F.2d 937, 136 USPQ 458, 459 (CCPA 1963). Moreover, the apparatus of Ohmi is capable of processing an insulator film in the sample.

Regarding the above apparatus claims, it should be noted that a claim containing a “recitation with respect to the manner in which a claimed apparatus is intended to be employed does not differentiate the claimed apparatus from a prior art apparatus” if the prior art apparatus teaches all the structural limitations of the claim. *Ex parte Masham*, 2 USPQ2d 1647 (Bd. Pat. App. & Inter. 1987).

(10) Response to Argument

A) Appellant has argued that one of ordinary skill in the art reading the specification would understand that the “fine pattern” is the same fine pattern referred to on page 6, line 21 of 0.2 μm or smaller. It is acknowledged that in the **background** section (prior art) of the specification that “fine pattern” is defined as 0.2 μm or smaller (col. 3, lines 33-37, USP 6,197,151); however, this dimension) is not disclosed in the current invention of the specification (col. 5, lines 7-10, (USP 6,197,151). Therefore, the current invention has no support for the limitation of a “fine pattern” is 0.2 μm or smaller.

B) Appellant has argued that the purpose of the magnetic coils (magnetic field forming means) of Heinrich is to vary the plasma volume rather than to provide a higher plasma density at the outer periphery of the sample than in the center of the sample, as required by the present means-plus-function claim language.

It should be noted that applicant has invoked 35 U.S.C. 112, sixth paragraph in the instant application. Thus, where means plus function language is used to define the characteristics of an apparatus, such language must be interpreted to read on only the structures or materials disclosed in the specification and “equivalents thereof” that correspond to the recited function. Furthermore, the claimed means plus function limitations are given their broadest reasonable interpretation consistent with all corresponding structures or materials described in the specification and their equivalents including the manner in which the claimed functions are performed. In the instant case, appellant’s magnetic field forming means 230, 240 (elected species, Fig. 28) is structurally equivalent to the magnetic field forming means Sp (Fig.

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2C) of Heinrich since it is an electromagnetic coil, it is located in the same positions around the chamber (i.e. top, bottom, and side), and the magnetic flux created by one of the coils cancels the magnetic flux of the other of the coils at the center of the sample and superimposes on the magnetic flux of the other of the coils at the portion within the outer periphery (note. magnetic field lines in Heinrich are horizontally and vertically (Fig. 2C, col. 5, lines 26-53) which is similar to magnetic field lines of current invention (Fig. 28)).

Next, due to the inherent structure, arrangement, and function of the magnetic field forming means Sp of Heinrich (Fig. 2C), a higher plasma density at the outer periphery of the sample than in the center of the sample will occur. This is because the magnetic field strength is higher (stronger) at the location closest to the magnets, which are located near the periphery of the sample (Fig. 2C). As a result of the magnetic field strength being higher near the periphery of the sample, then the magnetic field pushes the electrons closer to peripheral portion of the sample and hence the plasma density is higher at the peripheral portion of the sample.

Furthermore, as stated above, since the structure of the magnetic field forming means Sp of Heinrich is equivalent to appellant's magnetic field forming means 230, 240, then to alter the plasma density across the sample (i.e. higher plasma density at the periphery of the sample than at the center of the sample) the user simply needs to modify the current flow through the electromagnetic coils which is considered intended use of the apparatus. Therefore, a recitation of the intended use of the claimed invention must result in a structural difference between the claimed invention and the prior art in order to patentably distinguish the claimed invention from the prior art. If the prior art structure is capable of performing the intended use, then it meets the claim. Thus, the claimed structure of the magnetic field forming means is met by magnetic coils

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of Heinrich, and thus apparatus of Collins et al. in view of Ohmi, Lenz et al., Heinrich et al., and Mintz satisfies the claimed requirement of a magnetic field forming means for forming a magnetic field designed to generate increased plasma density at a portion within an outer periphery of the sample which is greater than the plasma density at the center of the sample.

C) Appellant has argued that Mintz fails to teach a claimed means to maintain the plasma density within the specific claimed range by combining the setting of the magnetic field value only to a value smaller than 30 Gauss.

As stated above, where means plus function language is used to define the characteristics of an apparatus, such language must be interpreted to read on only the structures or materials disclosed in the specification and “equivalents thereof” that correspond to the recited function. Furthermore, the claimed means plus function limitations are given their broadest reasonable interpretation consistent with all corresponding structures or materials described in the specification and their equivalents including the manner in which the claimed functions are performed. Furthermore, it should be noted that one cannot show nonobviousness by attacking references individually where the rejections are based on combinations of references. See *In re Keller*, 642 F.2d 413, 208 USPQ 871 (CCPA 1981); *In re Merck & Co.*, 800 F.2d 1091, 231 USPQ 375 (Fed. Cir. 1986). In the instant case, the structure of the claimed means to maintain the plasma density is shown by combination Collins’460 in view of Ohmi’417, Lenz’ 720, Heinrich’394, and Mintz’457. Collins teaches the structure for the high-frequency electric power having a frequency between 30-300 MHz, an electrode gap size of 30-100 mm, an atmospheric pressure between 0.4 Pa and 4.0 Pa. Heinrich teaches the structure of a magnetic forming means.

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Mintz teaches setting the magnetic field value only to a smaller than 30 gauss. In addition as stated above, plasma density is not a parameter that is set or controlled directly. In fact, plasma density is set as a result of controlling process parameters such as current to magnetic coils, pressure, power, and electrode spacing. Thus, since Collins et al. disclose a high frequency electric power source of 30-300 MHz, an electrode spacing of 30-100 mm, a pressure of 0.4 Pa and 4.0 Pa., Heinrich discloses magnetic field forming means, and Mintz discloses a magnetic field smaller than 30 gauss, then it is inherent that the resulting plasma density generated in Collins in view of Ohmi et al., Lenz et al., Heinrich, and Mintz will fall between the range of $5 \times 10^{10} \text{ cm}^{-3}$ to $5 \times 10^{11} \text{ cm}^{-3}$. Therefore, the apparatus of Collins et al. in view of Ohmi, Lenz et al., Heinrich et al, and Mintz satisfies the claimed requirement of a means to maintain the plasma density within the specific claimed range by combining the setting of the magnetic field value only to a value smaller than 30 Gauss.

D) Appellant has argued that the ranges specified in Collins are much broader ranges than those of the present claimed invention.

First, it should be noted that since there is overlap and the claimed range is disclosed in the reference, then it is inherent that the claimed range is anticipated by Collins. In the instant case, Collins et al. discloses a high frequency electric power source of 50-600 MHz, (claimed range-30-300 MHz, an electrode spacing of 50-300 mm (claimed range- 30-100 mm), and a pressure of 0.267-26.66 Pa (0.4-4.0 Pa) which anticipates the claimed range. Furthermore, where the general conditions of a claim are disclosed in the prior art, it is not inventive to discover the optimum or workable ranges by routine experimentation.” In re Aller, 220 F.2d 454,

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456, 105 USPQ 233, 235 (CCPA 1955). Hence, it would have been obvious to one of ordinary skill in the art to optimize the (i.e. power, electrode spacing, pressure, current to the magnetic coil) during routine experimentation to achieve the desired plasma density to etch the wafer. Therefore, the apparatus of Collins et al. in view of Ohmi, Lenz et al., Heinrich et al, and Mintz satisfies the claimed requirement.

E) Appellant has argued that with regards to claim 88, there is no teaching of either the specific claimed plasma density range, or its provision of improved workability on samples of 300 mm or larger.

As stated above, a specific plasma density is achieved as a result of controlling process parameters such as current to the magnetic coils, pressure, power, and electrode spacing. Concerning improved workability on samples of 300 mm or larger, this is considered simply a result of operating the apparatus within specified parameters. Furthermore, the claimed language of “improves workability” fails to further limit the claims and moreover adds no structure to the apparatus claims. Thus, it should be noted that a claim containing a “recitation with respect to the manner in which a claimed apparatus is intended to be employed does not differentiate the claimed apparatus from a prior art apparatus” if the prior art apparatus teaches all the structural limitations of the claim. *Ex parte Masham*, 2 USPQ2d 1647 (Bd. Pat. App. & Inter. 1987). Therefore, since the structure of the apparatus of Collins et al. in view of Ohmi, Lenz et al., Heinrich et al, and Mintz achieves the desired claimed plasma density range, then the apparatus satisfies the claimed requirement.

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F) Appellant has argued that concerning claims 89 and 90, the Heinrich reference fails to suggest the positioning and the diameter of the coils being used to generate increased plasma at a portion within the outer periphery of the sample which is greater than the plasma at the center of the sample.

First, it should be noted that the position of the coils of Heinrich (Figure 2c) are at the same relative position as the coils in appellant's application (Figure 28). Next, referring to column 5, lines 45-53, Heinrich indicates that the diameter of the magnetic coil can vary depending on the plasma density (abstract). Furthermore, it would have been obvious to one of ordinary skill in the art to optimize the position and diameter of the magnetic coil during routine experimentation in order to adjust the magnetic field to achieve the desired plasma density for etching a substrate. In addition, as previously stated, due to the position of the magnetic coils in Heinrich, the magnetic field strength is higher (stronger) at the location closest to the magnets which are located near the periphery of the sample (Fig. 2C). Hence, as a result of the magnetic field strength being higher near the periphery of the sample, then the magnetic field pushes the electrons closer to peripheral portion of the sample and hence the plasma density is higher at the peripheral portion of the sample. Therefore, the apparatus of Collins et al. in view of Ohmi, Lenz et al., Heinrich et al, and Mintz satisfies the claimed requirement of having a position and a diameter of the coils to generate increased plasma at a portion within the outer periphery of the sample which is greater than the plasma at the center of the sample.

G. Appellant has argued that with respect to claim 91 Mintz fails to teach setting a magnetic field intensity on the sample to be less than 30 Gauss as part of the specific magnetic sealed

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forming means to generate increased plasma density at the outer periphery of the sample. First, it should be noted that the features upon which applicant relies (i.e., specific magnetic **sealed** forming means) are not recited in the rejected claim(s). Although the claims are interpreted in light of the specification, limitations from the specification are not read into the claims. See *In re Van Geuns*, 988 F.2d 1181, 26 USPQ2d 1057 (Fed. Cir. 1993). Second, concerning the magnetic field forming means setting the intensity of less than 30 Gauss, one cannot show nonobviousness by attacking references individually where the rejections are based on combinations of references. See *In re Keller*, 642 F.2d 413, 208 USPQ 871 (CCPA 1981); *In re Merck & Co.*, 800 F.2d 1091, 231 USPQ 375 (Fed. Cir. 1986). In the instant case, the structure of the magnetic field forming means Sp is taught by Heinrich (Fig. 2C). As stated above, due to the inherent structure, arrangement, and function of the magnetic field forming means Sp of Heinrich (Fig. 2C), a higher plasma density at the outer periphery of the sample than in the center of the sample will occur. This is because the magnetic field strength is higher (stronger) at the location closest to the magnets which are located near the periphery of the sample (Fig. 2C). Furthermore, since the structure of the magnetic field forming means Sp of Heinrich is equivalent to appellant's magnetic field forming means 230, 240, then to alter the plasma density across the sample (i.e. higher plasma density at the periphery of the sample than at the center of the sample) the user simply needs to modify the current flow through the electromagnetic coils which is considered intended use. Therefore, Mintz was applied to teach that it conventionally known in the art to set a magnetic field intensity on the sample to be less than 30 Gauss. Thus, since the claimed structure of the magnetic field forming means is met by magnetic coils of Heinrich, and Mintz teaches setting a magnetic field intensity on the sample to be less than 30

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Gauss, then the apparatus of Collins et al. in view of Ohmi, Lenz et al., Heinrich et al., and Mintz satisfies the claimed requirement of a magnetic field forming means for setting the magnetic field intensity on the sample to be less than 30 gauss.

H. Appellant has argued that with respect to claim 92 none of the cited prior art teaches maintaining a plasma density within a range of $5 \times 10^{10} \text{ cm}^{-3}$ to $5 \times 10^{11} \text{ cm}^{-3}$ to achieve the etching of a fine pattern of 0.2 mm or smaller on a wafer having a size of 300 mm or larger.

First, it should be noted, "etching of a fine pattern of 0.2 mm or smaller on a wafer having a size of 300 mm or larger" is considered an intended use of the apparatus. Expressions relating the apparatus to contents thereof during an intended operation are of no significance in determining patentability of the apparatus claim." Ex parte Thibault, 164 USPQ 666, 667 (Bd. App. 1969). Hence, a recitation of the intended use of the claimed invention must result in a structural difference between the claimed invention and the prior art in order to patentably distinguish the claimed invention from the prior art. If the prior art structure is capable of performing the intended use, then it meets the claim. In the instant case as stated above, the plasma density is set as a result of controlling process parameters such as current to magnetic coils, pressure, power, and electrode spacing. Since Collins et al. disclose the structure for a high frequency electric power source of 30-300 MHz, an electrode spacing of 30-100 mm, a pressure of 0.4 Pa and 4.0 Pa., Heinrich discloses a magnetic field forming means, and Mintz discloses a magnetic field smaller than 30 gauss, then it is inherent that the resulting plasma density generated in Collins in view of Ohmi et al., Lenz et al., Heinrich, and Mintz will fall between the range of $5 \times 10^{10} \text{ cm}^{-3}$ to $5 \times 10^{11} \text{ cm}^{-3}$. Thus, since the plasma system of Collins et al.

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in view of Ohmi et al., Lenz et al., Heinrich, and Mintz achieves the same plasma density as appellant's plasma system, then etching a fine pattern of 0.2 mm or smaller on a wafer having a size of 300 mm or larger is considered a result of operating the apparatus and an intended use of the apparatus. Therefore, the apparatus of Collins et al. in view of Ohmi, Lenz et al., Heinrich et al, and Mintz satisfies the claimed requirement of a means for etching a fine pattern of 0.2 mm or smaller on a wafer having a size of 300 mm or larger.

I. With regards to appellant's arguments with respect to claims 87-92 over Ohmi in view of Collins, Lenz, Heinrich, and Mintz and Koshiishi in view of Collins, Lenz, Heinrich, and Mintz, see Response to Arguments in sections B-H.

(11) Related Proceeding(s) Appendix

No decision rendered by a court or the Board is identified by the examiner in the Related Appeals and Interferences section of this examiner's answer.

In summary, each of the rejected claims is obvious for the reasons argued at length above. It is respectfully stressed that Collins et al. in view of Ohmi, Lenz et al., Heinrich et al, and Mintz provides the structure for a gas introducing means, a magnetic field forming means, a means for etching a fine pattern, and a bias electric power source. In addition, apparatus claims cover what a device is, not what a device does. Since an apparatus has been claimed, Collins et al. in view of Ohmi, Lenz et al., Heinrich et al, and Mintz satisfy the claimed apparatus requirements.

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For the above reasons, it is believed that the rejections should be sustained.

Respectfully submitted,

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